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Kämäräinen

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(54) **SEMICONDUCTOR DETECTOR HEAD AND A METHOD FOR MANUFACTURING THE SAME**

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(51) **Int. Cl.**

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H01L 31/0203	(2014.01)
H01L 31/18	(2006.01)
H01L 31/024	(2014.01)

(52) **U.S. Cl.**

CPC ***H01L 31/0203*** (2013.01); ***H01L 31/024*** (2013.01); ***H01L 31/02005*** (2013.01); ***H01L 31/18*** (2013.01)

(58) **Field of Classification Search**

CPC H01L 31/02005; H01L 31/024; H01L 31/018

USPC 257/433, E23.114, E23.115; 250/336, 250/336.1–395

See application file for complete search history.

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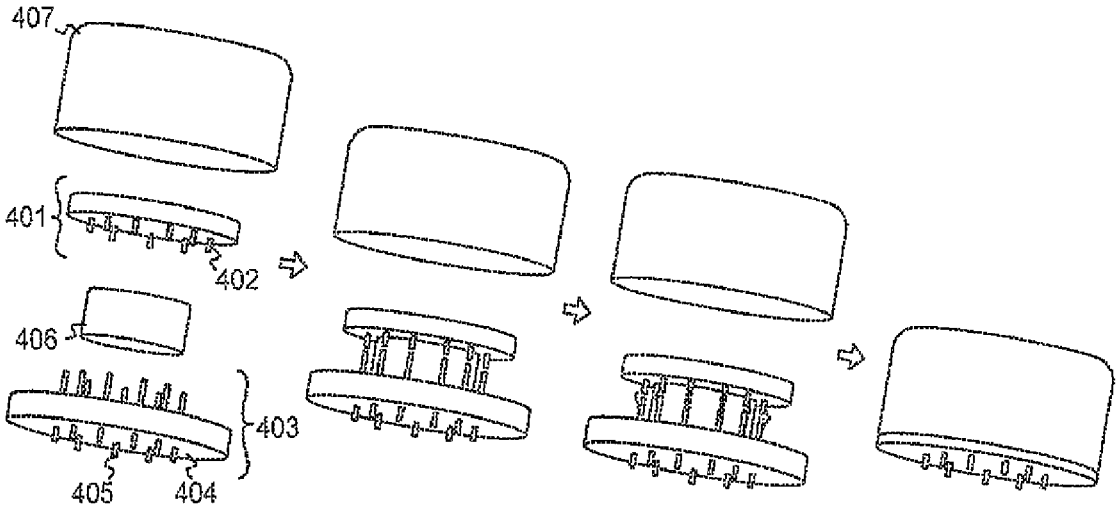
(57) **ABSTRACT**

A semiconductor detector head comprises a detector chip having a front side and a back side, and a substrate on the back side of said detector chip. Contact points are located on at least one of said substrate and said detector chip. A first set of contact pins protrude on an opposite side of said substrate than said detector chip. At least one of the contact pins of said first set is conductively coupled to at least one of said contact points. A base plate holds a second set of contact pins that protrude from said base plate towards the contact pins of said first set. Electric connections are made between matching pairs of contact pins of said first and second sets.

15 Claims, 2 Drawing Sheets



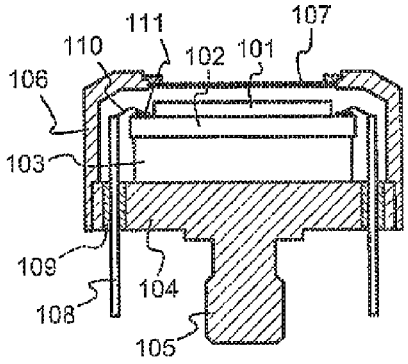


Fig. 1: PRIOR ART

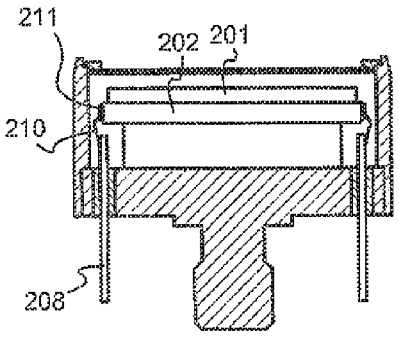


Fig. 2 : PRIOR ART

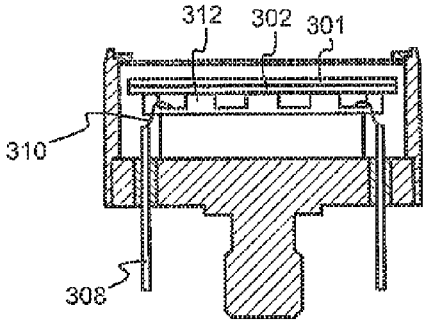


Fig. 3 : PRIOR ART

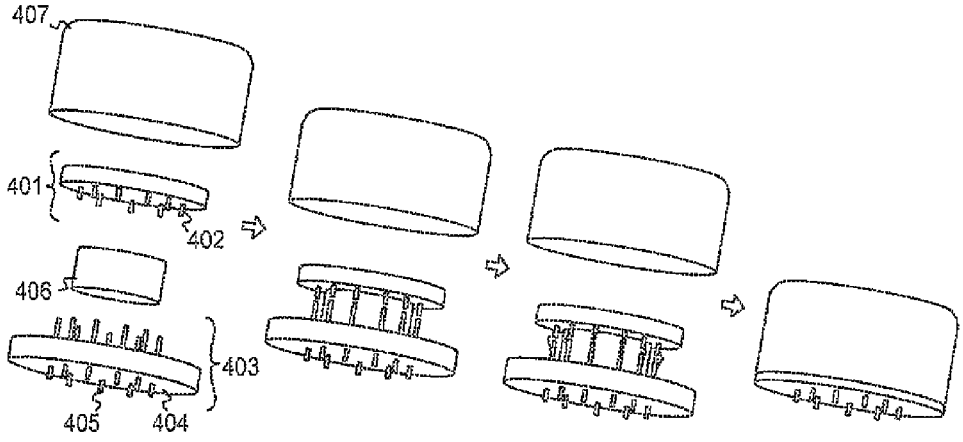


Fig. 4

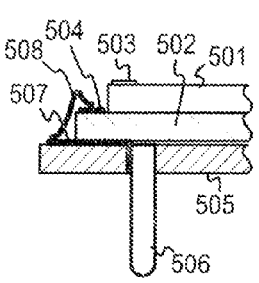


Fig. 5

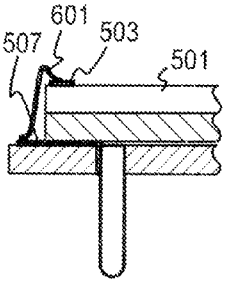


Fig. 6

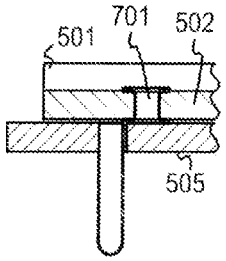


Fig. 7

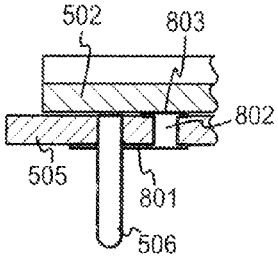


Fig. 8

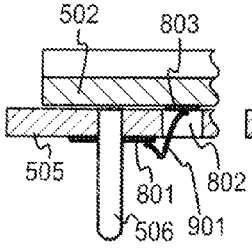


Fig. 9

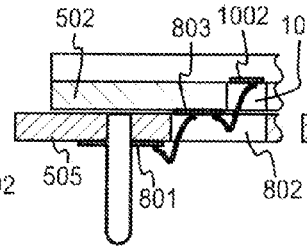


Fig. 10

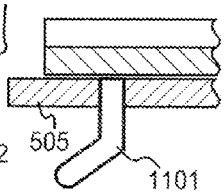


Fig. 11

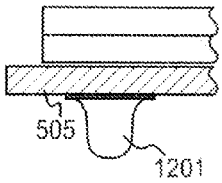


Fig. 12

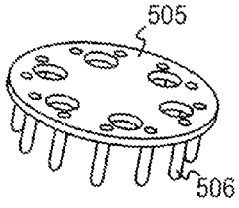


Fig. 13

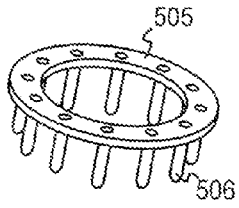


Fig. 14

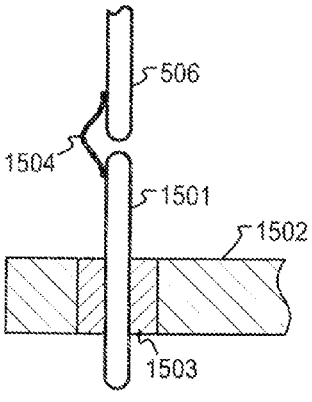


Fig. 15

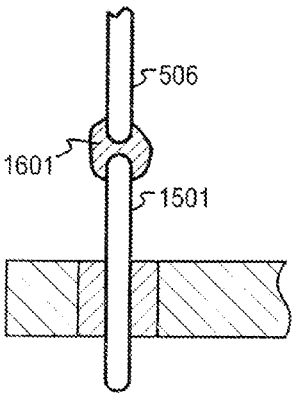


Fig. 16

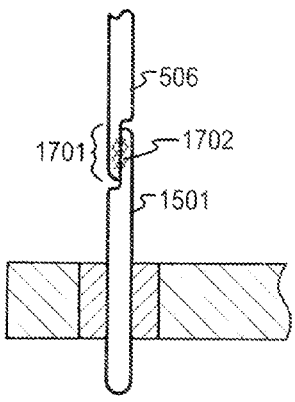


Fig. 17

SEMICONDUCTOR DETECTOR HEAD AND A METHOD FOR MANUFACTURING THE SAME

TECHNICAL FIELD

This invention is related to the general technical field of semiconductor radiation detectors. Especially the invention is related to such semiconductor radiation detectors that are enclosed in hermetically sealed covers or enclosures.

BACKGROUND OF THE INVENTION

Effective operation of certain semiconductor radiation detectors, such as PIN diode (p-type—intrinsic—n-type) detectors and SDDs (silicon drift detectors), benefits from sealing the detector crystal and its immediate electric contacts in a gas-tight enclosure known as the detector can. A radiation window at the front face of the detector can allows radiation to enter, while the back side of the can has the attachment means and contact pins that are needed to couple the detector mechanically, electrically, and thermally to the radiation-detecting appliance. A thermoelectric cooler, such as a Peltier element, is typically included in the entity, which in assembled form is frequently referred to as the detector head.

FIG. **1** illustrates a prior art detector head. The detector chip **101** or is attached to a substrate **102**, which in turn is attached to a thermoelectric cooler **103**. A base plate **104** with an protruding attachment bolt **106** supports the arrangement and closes the bottom of the detector can **106**, the front face of which has an opening covered by a radiation window **107**. The graphical illustration is simplified and omits possible intermediate shielding layers and other features that are not essential for understanding the background of the present invention.

Contact pins **108** go through holes in the base plate **104**, and are electrically isolated therefrom by insulator sleeves **109**. The entity that consists of the base plate **104**, the attachment bolt **105**, the contact pins **108**, and the insulator sleeves **109** is sometimes called the header. A bonding wire **110** connects the top end of each contact pin **108** to a bonding pad **111** on the top surface of the substrate **102**. Further bonding wires (not shown) may constitute the electric connections between areas of the substrate **102** and respective contact pads on the detector chip **101**.

The sensitivity of the detector is in principle the better, the larger is the detector chip: the larger surface of the detector chip collects more photons, increasing the pulse frequency. In the arrangement of FIG. **1** the substrate **102**, and thus also the detector chip **101**, must be smaller in diameter than the circle formed by the contact pins **108**, because the bonding wedge must be able to touch the top ends of the contact pins, as well as the bonding pads on the substrate **102** and detector chip **101**, from above. Basically it would be possible to make the whole detector head larger in diameter, but that would make it more difficult to place it close to the sample from which originates the radiation to be detected. The diameter of the ring of contact pins must always be significantly smaller than the diameter of the base plate, because hermetically sealing and electrically insulating the contact pin holes in the base plate necessitate the use of an insulator sleeve that completely encircles the contact pin and has a certain minimum wall thickness.

FIGS. **2** and **3** illustrate known detector heads that aim at avoiding the size-limiting effect of the circle of contact pins. The structure of FIG. **2** is known from the patent publication EP 2286275. The bonding is made from the side, so the bonding wire **210** connects the side surface of the contact pin **208** to a bonding pad **211** located on a vertical surface of the substrate **202**. In this arrangement the contact pins are shorter than in the arrangement of FIG. **1**, and the upper limit for the diameter of the substrate **202** (and consequently, to almost the same extent, for the diameter of the detector chip **201**) is determined by the diameter of the circle of contact pins plus the marginal difference allowed by the bonding. In practice one may say that it is the diameter of the circle of contact pins that defines the maximum diameter of the substrate.

The structure of FIG. **3** is known from the patent publication US 2012/0228498, The detector chip **301** is flip-chip-bonded to a first substrate **302**, under which is a second substrate **312**, the outer edge of which defines cavities. For connections to the contact pins, bonding wires **310** go between the top ends of the contact pins **308** and bonding pads (not separately shown) located in said cavities. Bonding to the top side of the detector chip **301** is typically also needed, although not shown in FIG. **3**. The diameter of the second substrate **312** must be smaller than that of the circle of contact pins, but the diameter of the first substrate **302** and the detector chip **301** can be of the same size or even larger than the diameter of the circle of contact pins.

A need exists for detector head structures that would enable the detector chip to have a large area while simultaneously making the structure easy to manufacture and reliable in use. For example the solution shown in FIG. **2** still has the limitation that the substrate (and therefore also the detector chip) cannot be substantially larger than the circle of contact pins. The structure of FIG. **3** requires flip-chip bonding of the detector chip, which requires special equipment in manufacturing and may lead to lower yield due to difficulties in the manufacturing process.

SUMMARY OF THE INVENTION

The following presents a simplified summary in order to provide a basic understanding of some aspects of various invention embodiments. The summary is not an extensive overview of the invention. it is neither intended to identify key or critical elements of the invention nor to delineate the scope of the invention.

The following summary merely presents some concepts of the invention in a simplified form as a prelude to a more detailed description of exemplifying embodiments of the invention.

In accordance with a first aspect of the invention, there is provided a detector head that comprises:

- a detector chip having a front side and a back side,
- a substrate on the back side of said detector chip,
- contact points on at least one of said substrate and said detector chip,
- a first set of protruding contact pins on an opposite side of said substrate than said detector chip, wherein at least one of the contact pins of said first set is conductively coupled to at least one of said contact points,
- a base plate.
- a second set of contact pins protruding from said base plate towards the contact pins of said first set, and
- electric connections between matching pairs of contact pins of said first and second sets.

In accordance with a second aspect of the invention, there is provided a method for manufacturing a detector head so that the method comprises:

- attaching a substrate to a back side of a detector chip, electrically connecting contact points that are located on at least one of said substrate and said detector chip to a

first set of protruding contact pins that are located on an opposite side of said substrate than said detector chip, and

electrically connecting contact pins of said first set to contacts pins of a second set that protrude from a base plate towards the contact pins of said first set.

According to an objective of the present invention, the detector chip should occupy as much as possible of the available space in the front part of a detector head. According to another objective of the present invention, the connections to and from the detector chip should be made in a way that enables simple and reliable manufacturing and operation.

These and further objectives and advantages of the invention are achieved by using two sets of contact pins. The so-called first or upper set of contact pins, which may also comprise contact studs, is first integrated with the detector chip and its substrate. Connections between the contact pins or studs and relevant parts of the integrated assembly may be made utilizing any side or even both sides of the assembly. A separate carrier may be used, to which the contact pins of the first sets are attached. The first set of contact pins or studs is aligned with the so-called second or lower set of contact pins that constitute a part of a header that supports the whole detector head and may act as a lid that closes the lower end of a detector can, if one is used. Connections between contact pins of the first and second sets can be made by suitable means, including but not being limited to bonding, gluing, soldering, and welding.

The exemplary embodiments of the invention presented in this patent application are not to be interpreted to pose limitations to the applicability of the appended claims. The verb "to comprise" is used in this patent application as an open limitation that does not exclude the existence of also unrecited features. The features recited in depending claims are mutually freely combinable unless otherwise explicitly stated.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** illustrates a detector head according to prior art,

FIG. **2** illustrates another detector head according to prior art,

FIG. **3** illustrates another detector head according to prior art,

FIG. **4** illustrates a method for manufacturing a semiconductor detector head according to an embodiment of the invention,

FIGS. **5-12** illustrate details of semiconductor heads according to embodiments of the invention,

FIG. **13** illustrates a carrier for use in a semiconductor head according to an embodiment of the invention,

FIG. **14** illustrates another carrier for use in a semiconductor head according to an embodiment of the invention, and

FIGS. **15-17** illustrate details of making electrical connections between contact pins in semiconductor heads according to embodiments of the invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

FIG. **4** is a simplified schematic illustration of manufacturing a semiconductor detector head according to an embodiment of the invention. A first entity **401** comprises at least a detector chip and a substrate, which are not separately shown in FIG. **4**. Advantageous ways of constructing the first entity, and especially the possibility of including a carrier in addition to the detector chip and the substrate, are discussed in more detail later.

The first entity **401** comprises also a first set of contact pins **402**. The purpose of the contact pins is to provide means for making electrical connections to desired parts of the first entity **401**. At least one of the contact pins is conductively coupled to at least one contact point that is located on the substrate or on the detector chip.

A second entity **403** comprises a base plate **404** and a second set of contact pins **405** that protrude from the base plate on that side that faces the first entity **401**. The contact pins of the second set may go through the base plate **404** so that their ends are accessible on its other (lower) side. Also other possibilities exist for making electric connections between contact pins of the second set and any further electric parts of a measurement apparatus. If the base plate **404** is made of—or otherwise comprises—electrically conductive material, insulator sleeves or other suitable kind of electric isolation must be used to keep the contact pins of the second set from being short-circuited through the base plate.

A thermoelectric cooler **406** may be provided: advantageously it is located between the first and second entities **401** and **403**. Structural details that have little significance to the embodiments discussed here are not shown. For example, a centrally located attachment bolt or other kind of mechanical attachment means may appear as a part of the base plate **404** or in close association with it.

The second step from the left shows how the first and second entities are brought together so that the thermoelectric cooler is sandwiched between them. The contact pins of the first and second sets form matching pairs, so that in each matching pair the corresponding ends of the contact pins come close to or into contact with each other, The third step from the left shows how electric connections are made between matching pairs of contact pins of said first and second sets. The manufacturing method may comprise attaching the thermoelectric cooler to the base plate before the step of electrically connecting the contact pins of the first set to contact pins of the second set.

In the fourth step a cover, which here takes the form of a detector can **407**, is placed over the whole assembly and attached to the base plate. Together with the base plate, the detector can **407** forms a hermetically sealed enclosure that encloses the detector chip, the substrate, the first set of protruding contact pins, that part of the second set of contact pins that protrudes from the base plate towards the contact pins of the first set, and the electric connections between matching pairs of contact pins of the first and second sets. A radiation window (not separately shown) in the detector can allows radiation to reach the detector chip.

It is not necessary to enclose the detector head in a detector can or to cover it in any way. Measurement arrangements exist where the semiconductor radiation detector may remain exposed. Such arrangements frequently involve a chamber, in which both the sample to be measured and the detector head are located, so that pumping a vacuum in the chamber or otherwise affecting the gaseous atmosphere inside the chamber provides the required advantageous environmental conditions.

The contact pins of the first set may be attached directly to the substrate, so that they protrude to an opposite direction from the substrate than the detector chip. However, in many cases it is more advantageous to use a separate carrier, to

which the contact pins of the first set are attached, A separate carrier may serve as an additional mechanical support, and it may give more possibilities for designing the conductive tracks, bonding pads, and/or other kinds of electric connections.

FIGS. **5** to **12** illustrate some details of embodiments where such a carrier is used. These details do not constitute any exhaustive list of possible implementations; they are not exclusive alternatives of each other: and any of them can be used in any combination with any other features and embodiments of the invention. Concerning the task of making connections to the detector chip it should be noted that an SDD chip frequently requires making connections by bonding to its both sides. A PIN diode as a detector element may have e.g. bonded connections to its top side and a single contact on the bottom side that is made with conductive glue.

FIG. **5** is a partial cross section of a part of a semiconductor detector head. The topmost layer in the stack of layers is a detector chip **501**, which has a front side (facing upwards in FIG. **5**) and a back side. A substrate **502** is located on the back side of the detector chip. Contact points exist on the substrate **502** and/or on the detector chip **501** for making electric connections; in FIG. **5** examples of contact points appear as contact pads **503** and **504** on the detector chip and the substrate respectively.

As a further layer of what would be the first entity in the vocabulary used above to describe FIG. **4**, the semiconductor detector head of FIG. **5** comprises a carrier **505**. The carrier is located on the opposite side of the substrate **502** than the detector chip **501**. The surfaces of the carrier can be referred to by saying that the carrier **505** has a front side that faces the substrate **502**, and a back side, which in FIG. **5** is downwards.

A contact pin **506** is seen in FIG. **5**. The contact pin **506** is one of a first set of protruding contact pins located on an opposite side of the substrate **502** than the detector chip **501**. In particular the contact pin **506**—as well as other contact pins of the first set—are attached to the carrier **505** and protrude out of its back side. The contact pin **506** reaches at least partly through the carrier **505**; here its top end is essentially flush with the front side of the carrier.

At least one of the contact pins of said first set is conductively coupled to at least one of the contact points that are located on the detector chip **501** and/or the substrate **502**. FIG. **5** illustrates one way of making such a conductive coupling. The carrier **505** comprises at least one conductive area on its surface. in the embodiment of FIG. **5** this is a conductive area **507** on the front surface of the carrier **505**. It is conductively coupled to the contact pin **506** at (or close to the point where the proximal end of the contact pin **506** comes through the carrier **505**. In the illustration of FIG. **5** the conductive area continues as a metallization on a wall of the hole in which the contact pin **506** is installed.

The diameter of the carrier **505** is slightly larger than the diameter of any of the substrate **502** and the detector chip, leaving some of the carrier visible when looked from above. This way at least a part of the conductive area **507** is exposed and accessible. A conductive coupling is made between the conductive area **507** and the contact point **504** on the exposed surface of the substrate **502**. In the embodiment of FIG. **5** this conductive coupling appears in the form of a bonding wire **508**.

FIG. **6** illustrates an embodiment in which a bonding wire **601** implements a conductive coupling between the conductive area **507** and the contact point **503** on the detector chip. If no similar bonded connections need to be made to any contact points at the edge of the substrate, the detector chip does not need to leave any exposed regions at the edge of the substrate. Therefore the diameter of the detector chip **501** is the same as that of the substrate in the embodiment of FIG. **6**. It is also possible to combine the techniques illustrated in FIGS. **5** and **6**: at some parts the bonding from a conductive area on the carrier may go to the substrate while at others it may go directly to the detector chip. Such a combination may be facilitated by forming the outer edge of the substrate and detector chip differently, so that at some parts the substrate surface is exposed while at others it is not.

The substrate of a detector chip may have some features known from printed circuit boards, such as so-called plated vias that constitute a conductive coupling right through the substrate. FIG. **7** illustrates an embodiment in which the substrate **502** comprises a plated via. The material of the substrate **502** defines an opening **701**, walls of which are at least partially plated with metal or other conductive substance. The plating continues to some extent to the upper and lower sides of the substrate, where electrical connections are made to a conductive area on the front surface of the carrier on one hand and to an electrode on the back surface of the detector chip on the other hand.

The plated via technique can be used to make electric connections through the carrier. FIG. **8** illustrates en embodiment in which the carrier **505** comprises a conductive area **801** on its back surface. The conductive area **801** is conductively coupled to the contact pin **506** at or close to the point where the protruding portion of the contact pin **506** meets the back surface of the carrier **505**. The carrier defines an opening **802**, and the substrate **502** comprises an electrical contact **803** that at least partly overlaps with the opening **802**. The conductive area **801** and said electrical contact **803** are conductively coupled to each other through the opening **802**. in this embodiment such conductive coupling is made through a conductive plating along at least a part of the edge of the opening **802**, so the opening **802** constitutes a plated via through the carrier **505**.

FIG. **9** illustrates an embodiment that has some of the same features as that illustrated in FIG. **8**. The conductive area **801** on the back surface of the carrier **505** is conductively coupled to the contact pin **506** at or close to the point where the protruding portion of the contact pin **506** meets the back surface of the carrier **505**. The carrier also defines an opening **802**, and the substrate **502** comprises an electrical contact **803** that at least partly overlaps with the opening **802**. The conductive area **801** and said electrical contact **803** are conductively coupled to each other through the opening **802**, but in this embodiment the conductive coupling takes the form of a bonding wire **901**. Bonding from below is possible during the manufacturing method if the semiconductor detector head is assembled in stages. At the time when the bonding wire **901** is put into place, the first entity that comprises the detector chip, the substrate, and the carrier has been assembled but it has not yet been attached to the second entity that comprises the base plate and the thermoelectric cooler.

FIG. **10** illustrates an embodiment where the substrate **502** defines a further opening **1001** that at least partly overlaps the opening **802** in the carrier. A conductive coupling exists to an electrode **1002** on the back surface of the detector chip through said further opening **1001**. in particular, the conductive area **801** on the back surface of the carrier **605** is bonded to an electrical contact **803** on the substrate, from which a further bonding wire goes through the further opening **1001** to the electrode **1002**. If the dimensions allow, a bonding wire could go even from the conductive area **801** on the back surface of the carrier **505** directly to the electrode **1002**, through both openings **802** and **1001**.

The invention does not require that the contact pins of the first set should be straight pins that protrude perpendicularly out of the back surface of the carrier (or the substrate, if no separate carrier is used). Straight pins that protrude obliquely out of the back side of the carrier could be used. FIG. **11** illustrates a further alternative that comprises curved contact pins **1101** that protrude out of the back surface of the carrier **505**. FIG. **12** illustrates another further alternative in which the contact pins of the first set comprise a stud **1201** that protrudes out of the back side of the carrier **505**.

Various alternatives are possible concerning the number, location, shape, and use of openings (if any) in the carrier. FIG. **13** illustrates a planar carrier **505**. out of the back side of which the contact pins **506** of the first set protrude. In this embodiment the carrier **505** defines half as many openings as there are contact pins in the first set, and each opening is located roughly between two contact pins. FIG. **14** illustrates a carrier **505**, which has a generally annular form so that it defines only one large opening in the center. Such a large central opening can be used for all bonding and other connections to the substrate, but also to allow the thermoelectric cooler or other centrally located component to extend through the carrier and touch directly (or indirectly through some radiation barriers, glue, or other intermediate layers, if needed) the substrate of the detector chip.

FIGS. **15** to **17** introduce some examples of how to make the electric connections between matching pairs of contact pins of the first and second sets. A contact pin **1501** of the second set is shown as being installed to a base plate **1502** through an electrically insulating sleeve **1503**. One end (the lower end in FIG. **15**) of the contact pin **1501** protrudes out of the semiconductor detector head for electrically coupling parts of the semiconductor detector head with appropriate electric circuits of the radiation detection apparatus. The other end of the contact pin **1501** protrudes inwards from the base plate **1502**, and is located close to the protruding end of a contact pin **506** of the first set, so that these two form a matching pair. A bonding wire **1504** is bonded to the side surfaces of the pins **506** and **1501** of the first and second sets respectively. Bonding from the side is possible, because there is free space on the outer side of the semiconductor detector head before it is enclosed into the detector can.

FIG. **16** illustrates an alternative embodiment in which the electric connection between a matching pair of contact pins **506** and **1501** of the first and second sets comprises glue **1601**, which in this case is electrically conductive glue. If the contact pins are in direct contact with each other and the glue is only used to hold them in place, also non-conductive glue could be used. The use of a bonding wire and glue can also be combined so that the bonding wire implements the electric connection and the glue holds the bonding wire in place.

FIG. **17** illustrates an alternative embodiment in which the electric connection between a matching pair of contact pins **506** and **1501** of the first and second sets comprises a joining section **1701**, at which the forms of the matching portions of the two contact pins are such that they meet each other and ensure good and reliable electric connection. The joining section may also comprise a weld **1702** or other way of enforcing the mechanic and electric connection.

The techniques illustrated in FIGS. **16** and **17** for making the electric connection between a matching pair of contact pins involve a much larger thermal conductivity between the pair of contact pins than in solutions that use a bonding wire. This may make these techniques unusable or at least disadvantageous in solutions where thermal conductivity should be kept as small as possible, for example in order to keep the detector chip as effectively cooled as possible.

A method for manufacturing a semiconductor detector head according to an embodiment of the invention comprises attaching a substrate to a back side of a detector chip, and electrically connecting contact points that are located on the substrate and/or the detector chip to a first set of protruding contact pins. These are located on an opposite side of said substrate than said detector chip. The method comprises also electrically connecting contact pins of said first set to contacts pins of a second set that protrude from a base plate towards the contact pins of said first set. The method may comprise attaching a carrier to a different surface of the substrate than said detector chip, to which carrier the contact pins of said first set are attached.

if a thermoelectric cooler is used, the method may comprise attaching the thermoelectric cooler to the base plate before the step where contact pins of the first set are electrically connected to contact pins of the second set. This way two entities are formed for the assembling phase: a first entity comprises the detector chip, the substrate, and the carrier (if one is used). A second entity comprises the base plate (with the second set of contact pins attached to it) and the said thermoelectric cooler. These two entities are attached to each other by gluing first entity to the top of the thermoelectric cooler, before the assembling proceeds to electrically connecting the contact pins of the first set to contact pins of the second set.

The step of electrically connecting the contact pins of the first set to contact pins of the second set may comprise bonding or gluing a piece of electrically conductive wire to side surfaces of a matching pair of contact pins from the first and second sets. Alternatively it may comprise gluing the matching pair of contact pins directly to each other, or welding them together at a joining section.

The use of two sets of matching contact pins enables making the detector chip large, because at least in some embodiments of the invention there is no structural part below the detector chip that should have a larger diameter than the detector chip. In some embodiments at least one of the substrate or the carrier should be slightly larger than the detector chip, because some of their edge areas should remain exposed to enable the bonding wedge or other connection-making tool to reach them from above. However, at least the diameter of the ring of contact pins does not limit the size of the detector chip in any way.

It should be noted that the contact pins need not be arranged in a circular ring, and neither do any other structural parts like the detector chip need be round in any embodiment of the invention. Therefore, when one discusses possible limitations to dimensions, the advantages of the invention are not limited to making a round detector chip larger in diameter than a ring of contact pins. More generally it can be said that due to the present invention the way in which the contact pins are arranged places very few—if any—limitations to the size and form of the structures above them in the detector head.

The invention claimed is:

1. A semiconductor detector head, comprising:

a detector chip having a front side and a back side,

a substrate on the back side of said detector chip,

contact points on at least one of said substrate and said detector chip,

a first set of protruding contact pins on an opposite side of said substrate than said detector chip, wherein at least one of the contact pins of said first set is conductively coupled to at least one of said contact points,

a base plate,

a second set of contact pins protruding from said base plate towards the contact pins of said first set, and

bonded electric connections between matching pairs of contact pins of said first and second sets, said bonded electrical connections comprising bonding wires bonded to side surfaces of the respective pins of said first and second sets.

2. A semiconductor detector head according to claim **1**, wherein the contact pins of said first set are attached to the substrate and protrude to an opposite direction from the substrate than the detector chip.

3. A semiconductor detector head according to claim **1**, comprising a thermoelectric cooler between said base plate and said substrate.

4. A semiconductor detector head according to claim **1**, comprising a cover attached to said base plate and forming, together with said base plate, a hermetically sealed enclosure that encloses the detector chip, the substrate, the first set of protruding contact pins, that part of the second set of contact pins that protrudes from said base plate towards the contact pins of said first set, and the electric connections between matching pairs of contact pins of said first and second sets.

5. A semiconductor detector head according to claim **1**, wherein:

the semiconductor detector head comprises a carrier on said opposite side of said substrate than said detector chip,

said carrier has a front side facing said substrate and a back side, and

the contact pins of said first set are attached to said carrier and protrude out of its back side.

6. A semiconductor detector head according to claim **5**, wherein:

the front side of said carrier comprises a conductive area that is at least partly exposed, and

the semiconductor detector head comprises a conductive coupling between said conductive area and at least one of the following: a contact point on the detector chip, a contact point on an exposed surface of the substrate.

7. A semiconductor detector head according to claim **5**, wherein the contact pins of said first set comprise at least one of the following: straight pins that protrude perpendicularly out of the back side of the carrier, straight pins that protrude obliquely out of the back side of the carrier, curved pins that protrude out of the back side of the carrier, studs that protrude out of the back side of the carrier.

8. A semiconductor detector head according to claim **5**, wherein:

the carrier comprises at least one conductive area on its surface, and

said conductive area is conductively coupled to at least one of said contact pins of the first set.

9. A semiconductor detector head according to claim **8**, wherein:

said conductive area is on the back side of the carrier, and conductively coupled to said at least one of said contact pins of the first set at or close to the point where the contact pin separates from the carrier.

10. A semiconductor detector head according to claim **8**, wherein:

said at least one of said contact pins of the first set reaches at least partly through the carrier, and

said conductive area is on the front side of the carrier and conductively coupled to said at least one of said contact pins of the first set at or close to the point where a proximal end of the contact pin comes through the carrier.

11. A semiconductor detector head according to claim **5**, wherein:

the carrier comprises at least one conductive area on its back side,

the carrier defines an opening,

the substrate comprises an electrical contact that at least partly overlaps said opening, and

said conductive area and said electrical contact are conductively coupled to each other through said opening.

12. A semiconductor detector head according to claim **11**, wherein the conductive coupling between said conductive area and said electrical contact comprises one of the following:

a bonding wire, a conductive plating along an edge defining said opening.

13. A semiconductor detector head according to claim **11**, wherein:

the substrate defines a further opening that at least partly overlaps said opening in the carrier, and

the semiconductor detector head comprises a conductive coupling to the detector chip through said further opening.

14. A semiconductor detector head, comprising:

a detector chip having a front side and an opposed back side,

a substrate on the back side of said detector chip,

a carrier on said opposite side of said substrate than said detector chip, said carrier having a front side faceing said substrate and a back side and said carrier front side comprising a conductive area that is at least partly exposed,

contact points on at least one of said substrate and said detector chip,

a first set of protruding contact pins on an opposite side of said substrate than said detector chip attached to said carrier and protruding out of the carrier back side, wherein at least one of the contact pins of said first set is conductively coupled to at least one of said contact points,

a base plate,

a second set of contact pins protruding from said base plate towards the contact pins of said first set,

bonded electric connections between matching pairs of contact pins of said first and second sets, and

a conductive coupling between said conductive area and at least one of the following: a contact point on the detector chip a contact point on an exposed surface of the substrate.

15. A semiconductor detector head, comprising:

a detector chip having a front side and a back side,

a substrate on the back side of said detector chip,

contact points on at least one of said substrate and said detector chip,

a first set of protruding contact pins on an opposite side of said substrate than said detector chip, wherein at least one of the contact pins of said first set is conductively coupled to at least one of said contact points,

a base plate,

a second set of contact pins protruding from said base plate towards the contact pins of said first set,

electric connections between matching pairs of contact pins of said first and second sets, and

a carrier on said opposite side of said substrate than said detector chip having a front side facing said substrate and a back side, wherein:

the contact pins of said first set are attached to said carrier and protrude out of its back side,

the carrier comprises at least one conductive area on its back side,

the carrier defines an opening,

the substrate comprises an electrical contact that at least partly overlaps said opening, and

said conductive area and said electrical contact are conductively coupled to each other through said opening.

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